

Bioaccumulation Model Check-In

CPG-EPA Conference Call
January 29, 2019

Agenda / Objectives

- Review of FWM structure changes
- Review of questions from J. Clough
 - Model linkage questions
 - Empirical dataset
 - Modeling boundaries?
 - Inclusion of converted fillet data in FWM calibration dataset?
- Calibration efforts with updated FWM

Review of FWM Status

- Key changes to LPRSA FWM since Dec. 2017:
 - Added ED parameter
 - Was formerly calculated based on K_{ow}
 - Phytoplankton calculations
 - Now calculated using CFT algal carbon concentrations
 - Growth and consumption equations for fish and blue crab (no change for benthic inverts)
 - Now uses equations estimated from FB4 model
- These changes are deviations from the Arnot and Gobas model structure.

Model Linkage Questions (1 of 2)

- Treatment of OCSS (sediment OC) in model
 - Appears that there is an error in the dynamic model code
 - Will update; change does not appear to greatly impact calibration (<10% change)
- Use of CAC to estimate phytoplankton.
 - CAC from CFT model is ng/g of carbon
 - $C_{ww} = C_{\text{carbon}} \times (F_{\text{lipid}} + F_{\text{NLOC}})$
 - Convert to wet weight concentration using phytoplankton NLOC (default = 3.88%) and lipid fraction (default = 0.12%)
 - Distributions for lipid and water content for phytoplankton
 - $\text{NLOC} = 1 - (\text{moisture content}) - (\text{lipid})$

Model Linkage Questions (2 of 2)

- Zooplankton diet (100% phytoplankton)
 - Correct that zooplankton assumed to eat 100% phytoplankton
 - Could look at adding detrital particulates – would increase predicted zooplankton concentrations.

Chemical	Media	RM 0-6	RM 6-14.7	RM 14.7-Dam
2378-TCDD	detrital particulates	0.11	0.14	0.01
2378-TCDD	phytoplankton	0.02	0.009	0.0004
tetraCB	detrital particulates	123	177	150
tetraCB	phytoplankton	40	32	24
1234678-HpCDF	detrital particulates	0.31	0.5	0.4
1234678-HpCDF	phytoplankton	0.14	0.02	0.002

- Note that the CAC calculated value from the CFT model includes phytoplankton, sure this is needed because phytoplankton compartment based on CAC already accounts for more than just plankton in water column.
- Unused parameters from CFT output – your designations look correct.

Empirical Dataset – Boundaries

- Specific questions about empirical data
 - Mostly can be explained by inclusion of some samples in multiple modeling areas.
 - Based on typical foraging area of FWM species.
 - Discussed during December 2017 meeting.

FWM Group	Boundary Rule	Notes Regarding Typical Forage Area
Small forage fish	NA (0 miles)	Extremely limited foraging area (< 50 m).
American eel (both sizes)	0.5 miles	Limited foraging range (0.38 - 17 ha); no difference based on eel size.
Blue crab	0.5 miles	Limited foraging range observed during a 6-month tag/recapture study.
Carp	1 mile	Moderate foraging area – Studies reported areas of less 2.8 km or typically less than 1 km (and almost always less than 5 km).
Catfish	1 mile	Moderate foraging area (2 - 8 km).
White perch	0.5 miles	Limited foraging area (average of 1.4 km).
Bass	0.5 miles	Limited foraging area for both small (30 - 68 m) and large bass (60 - 120 m).

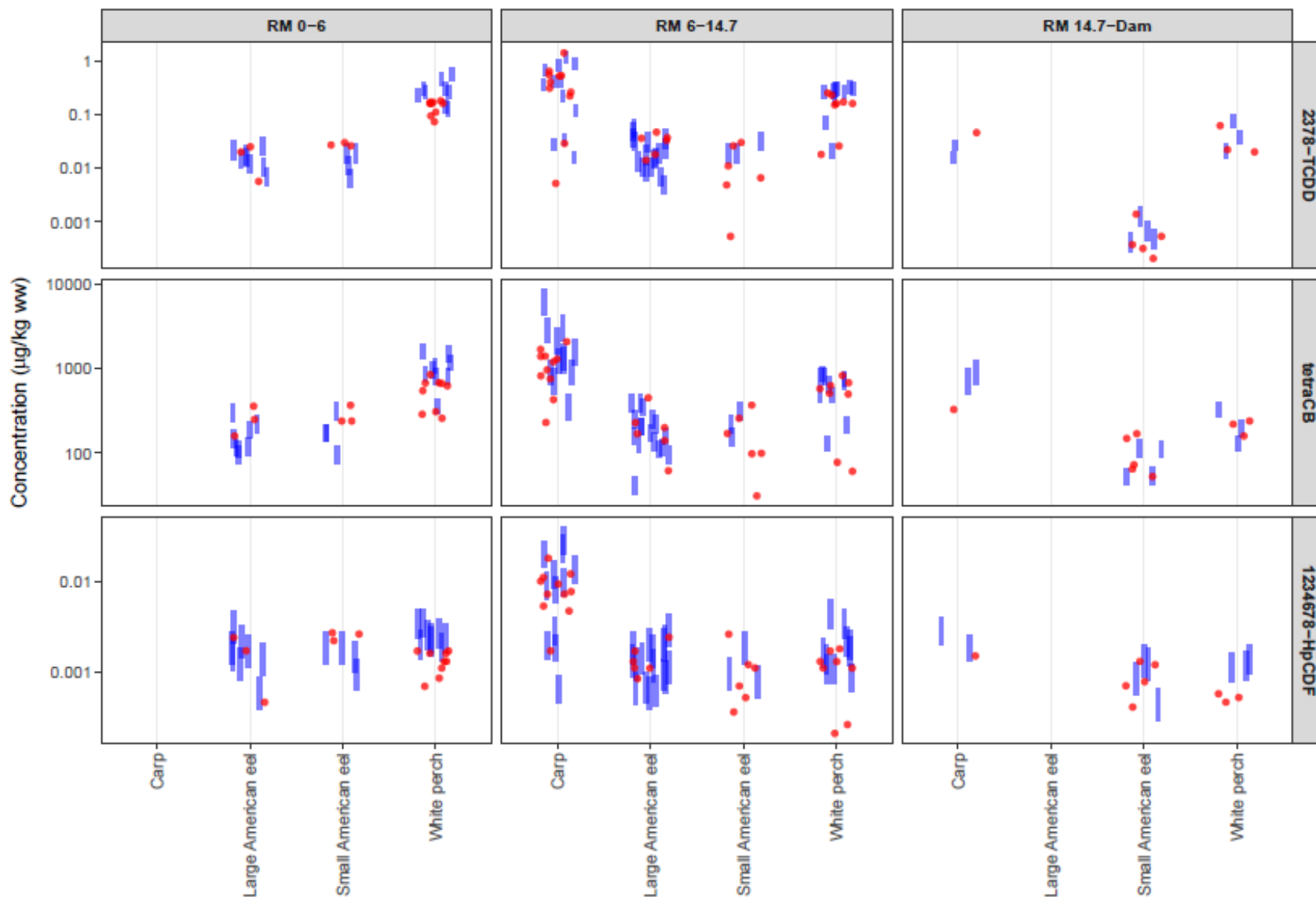
Empirical Dataset – other tissue types

- Use of non-whole body data to expand calibration dataset?
 - Crab – already done and included in dataset per EPA comments on 2015 report.
 - Other fish for which fillet data available
 - Carp, perch, and eel
 - Can use as part of model evaluation, but not calibration dataset (too much uncertainty)
- Figure from August 28 FWM call
(see next slide)

Evaluation of Fillet Data

Blue bars = WB conc. estimated using fillet data

Red dots = whole body conc.



Uncalibrated Model Results

(using steady-state model)

- No change for inverts
- Big changes for all fish (and crab) model compartments

Pre-FB4 Model

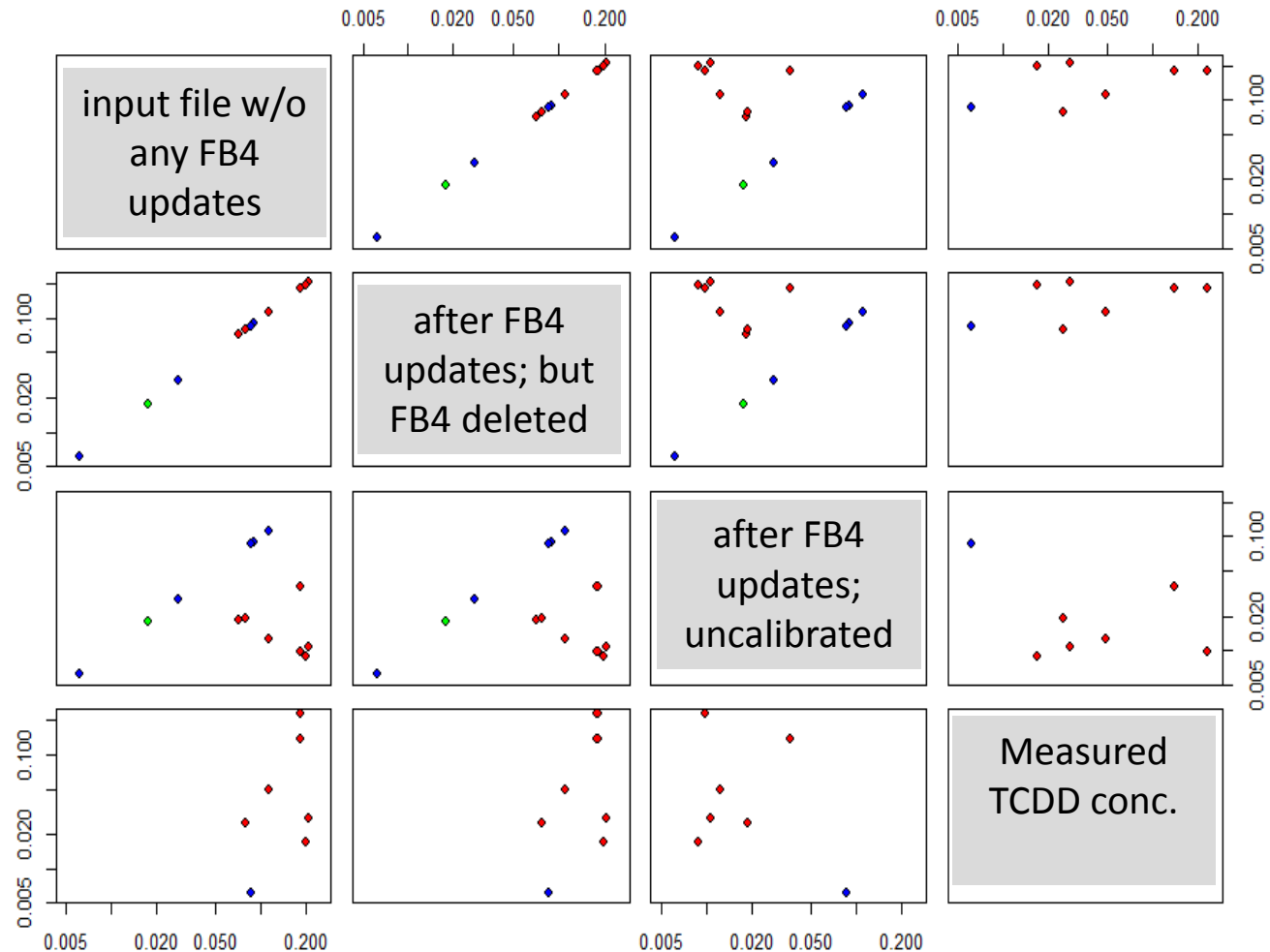
Species	2378-TCDD			TetraCB			1234678-HpCDF		
	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam
DEP (Invert)		50.8	10.4		6.2	3.7		7.2	1.6
FF (Invert)									
DET (Invert)									
C/O (Invert)	14.1			2.5			4.7		
Small FF fish		2.6			-1.1			-1.2	
Small forage fish	3.2	17.3	-1.7	-1.6	1.3	-1.1	1.9	-1.3	-1.8
Small American eel	7.4	103.1	20.8	-1.7	3.1	2.2	-1.4	2.1	1.1
Blue crab	2.3	17.8	-3.4	-1.0	3.9	2.3	-3.1	-1.2	-2.8
Carp		3.2	-1.6		-1.2	1.3		-1.3	1.1
Catfish	-1.3	10.3	-6.1	-2.0	2.8	1.8	-1.9	3.3	1.4
White perch	1.3	7.9	-2.7	-2.9	1.0	1.1	1.2	2.1	2.3
Large American eel	11.7	43.3		-1.2	3.1		-1.2	1.2	
Bass		13.5	4.2		1.9	-1.0		-1.0	-3.2
Average (all)	4.5	24.3	5.8	1.7	2.1	1.5	1.8	1.6	1.9
Average (priority)	22.0			2.2			1.8		

Post-FB4 Model

Species	2378-TCDD			TetraCB			1234678-HpCDF		
	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam
DEP (Invert)		47.3	9.6		5.8	4.3		7.4	2.0
FF (Invert)									
DET (Invert)									
C/O (Invert)	14.1			2.5			4.8		
Small FF fish		-1.4			-3.2			-5.8	
Small forage fish	-1.3	3.8	-10.3	-4.6	-2.7	-4.2	-2.8	-7.2	-8.7
Small American eel	-2.6	4.2	-1.3	-11.3	-4.3	-4.1	-28.1	-11.8	-22.4
Blue crab	-3.9	1.6	-42.9	-5.3	-2.0	-3.0	-32.5	-14.9	-28.7
Carp		-1.7	-9.5		-3.0	-1.7		-10.8	-6.2
Catfish	-23.6	-2.4	-201.2	-13.3	-2.7	-4.4	-39.8	-6.1	-10.5
White perch	-3.9	1.3	-20.3	-10.7	-4.7	-4.5	-3.9	-2.5	-2.0
Large American eel	-1.9	1.3		-10.0	-5.2		-21.3	-18.7	
Bass		-1.2	-6.5		-4.8	-10.7		-9.6	-28.7
Average (all)	6.2	2.1	41.7	9.2	3.6	4.7	21.4	9.7	15.3
Average (priority)	2.5			4.5			11.8		

Impact of FB4 updates

- Legend:
 - fish
 - inverts
 - phytoplankton
- Uncalibrated parameters
- Showing RM 0-6 predictions



Current Calibration (using steady-state model)

Uncalibrated

Species	2378-TCDD			TetraCB			1234678-HpCDF		
	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam
DEP (Invert)		47.3	9.6		5.8	4.3		7.4	2.0
FF (Invert)									
DET (Invert)									
C/O (Invert)	14.1			2.5			4.8		
Small FF fish		-1.4			-3.2			-5.8	
Small forage fish	-1.3	3.8	-10.3	-4.6	-2.7	-4.2	-2.8	-7.2	-8.7
Small American eel	-2.6	4.2	-1.3	-11.3	-4.3	-4.1	-28.1	-11.8	-22.4
Blue crab	-3.9	1.6	-42.9	-5.3	-2.0	-3.0	-32.5	-14.9	-28.7
Carp		-1.7	-9.5		-3.0	-1.7		-10.8	-6.2
Catfish	-23.6	-2.4	-201	-13.3	-2.7	-4.4	-39.8	-6.1	-10.5
White perch	-3.9	1.3	-20.3	-10.7	-4.7	-4.5	-3.9	-2.5	-2.0
Large American eel	-1.9	1.3		-10.0	-5.2		-21.3	-18.7	
Bass		-1.2	-6.5		-4.8	-10.7		-9.6	-28.7
Average (all)	6.2	2.1	41.7	9.2	3.6	4.7	21.4	9.7	15.3
Average (priority)	2.5			4.5			11.8		

Calibrated

Species	2378-TCDD			TetraCB			1234678-HpCDF		
	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam
DEP (Invert)		21.7	8.6		5.4	6.5		16.2	4.6
FF (Invert)									
DET (Invert)									
C/O (Invert)	11.5			5.7			8.0		
Small FF fish		1.1			-1.4			1.0	
Small forage fish	1.1	3.4	-7.6	-1.6	-1.1	-1.6	2.3	-1.1	-1.4
Small American eel	-1.6	4.8	1.2	-2.9	1.2	1.0	-2.3	1.5	-1.5
Blue crab	-2.0	2.2	-22.7	-1.7	1.6	1.2	-2.9	-1.1	-2.1
Carp		-1.5	-6.7		-2.7	-1.6		-1.3	1.2
Catfish	-5.2	1.4	-47.1	-4.9	-1.2	-1.9	-2.8	2.4	1.2
White perch	-2.1	1.5	-11.1	-3.6	-1.8	-1.4	1.6	2.7	2.8
Large American eel	-1.1	1.6		-2.3	1.1		-1.7	-1.1	
Bass		-1.3	-5.1		-1.8	-3.7		1.4	-2.2
Average (all)	2.2	2.1	14.5	2.8	1.5	1.8	2.3	1.5	1.8
Average (priority)	2.2			1.8			1.7		

Summary of Calibrated Parameter Values

	<u>TCDD</u>	<u>Tetra</u>	<u>HpCDF</u>
K_{ow} = used CFT model values	6.65	6	8.67
ED = adjusted as needed	0.2 (0.004-0.48)	0.7 (0.3-0.48)	0.05 (0.002-0.11)

(ranges based on calculations using K_{ow})

Metabolic rate constants:

	<u>inverts</u>	<u>small fish</u>	<u>crab</u>	<u>eel</u>	<u>carp</u>	<u>other fish</u>
Km for TCDD	0.02 0.007-0.024	0.005 0.002-0.082	0.0005 0.0005-0.045	0.006 0.0005-0.045	0.0004 0.0004-0.013	0.0005 0.0005-0.045
Km for TetraCB	0	0	0.0004 0.0004-0.014	0.0004 0.0004-0.014	0	0
Km for HpCDF	0.15 0.031-0.24	0.05 0.031-0.24	0.01 0.007-0.13	0.02 0.007-0.13	0.02 0.007-0.13	0.02 0.007-0.13

red = min values

black = default

blue = other value

Other parameters:

Water temperature (degrees C)	22	(default = ~13)
Dietary AE for inverts (NLOM and NLOC)	0.4	(default = 0.75)
Decreased sediment in diet of DEPs	-	(varies by area)
Weight for DEPs (RM 6-14.7)	1E-06	(default = 3.6E-05)

Pre- and Post-FB4 Calibration

Pre-FB4 Calibration (OLD)

Species	2378-TCDD			TetraCB			1234678-HpCDF		
	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam
DEP (Invert)		16.5	4.9		3.8	5.3		13.1	2.8
FF (Invert)									
DET (Invert)									
C/O (Invert)	6.3			3.9			6.0		
Small FF fish		1.8			1.1			1.7	
Small forage fish	1.6	5.1	-3.6	-1.0	1.4	1.3	4.3	1.7	1.1
Small American eel	-1.4	6.3	1.8	-2.1	1.5	1.8	-3.2	1.0	-2.2
Blue crab	-1.5	3.3	-16.6	1.2	3.0	2.5	-2.9	-1.0	-2.6
Carp		-2.5	-11.4		-1.2	1.5		-3.3	-2.4
Catfish	-12.2	-1.6	-101	-1.5	2.7	2.1	-4.6	1.4	-1.8
White perch	-8.1	-2.1	-32.0	-1.9	1.0	1.5	-1.7	-1.0	-1.1
Large American eel	-1.0	2.2		-1.2	2.2		-2.6	-1.8	
Bass		-1.4	-4.9		2.0	1.2		-1.5	-5.8
Average (all)	4.3	2.9	24.4	1.5	1.8	1.7	3.2	1.6	2.4
Average (priority)	3.4			1.8			1.7		

FB4 Calibration (CURRENT)

Species	2378-TCDD			TetraCB			1234678-HpCDF		
	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam	RM 0-6	RM 6-14.7	RM 14.7-Dam
DEP (Invert)		21.7	8.6		5.4	6.5		16.2	4.6
FF (Invert)									
DET (Invert)									
C/O (Invert)	11.5			5.7			8.0		
Small FF fish		1.1			-1.4			1.0	
Small forage fish	1.1	3.4	-7.6	-1.6	-1.1	-1.6	2.3	-1.1	-1.4
Small American eel	-1.6	4.8	1.2	-2.9	1.2	1.0	-2.3	1.5	-1.5
Blue crab	-2.0	2.2	-22.7	-1.7	1.6	1.2	-2.9	-1.1	-2.1
Carp		-1.5	-6.7		-2.7	-1.6		-1.3	1.2
Catfish	-5.2	1.4	-47.1	-4.9	-1.2	-1.9	-2.8	2.4	1.2
White perch	-2.1	1.5	-11.1	-3.6	-1.8	-1.4	1.6	2.7	2.8
Large American eel	-1.1	1.6		-2.3	1.1		-1.7	-1.1	
Bass		-1.3	-5.1		-1.8	-3.7		1.4	-2.2
Average (all)	2.2	2.1	14.5	2.8	1.5	1.8	2.3	1.5	1.8
Average (priority)	2.2			1.8			1.7		

Dynamic Model Results

- Model results showing
 - Uncalibrated
 - Current calibration (i.e., semi-calibrated)
- Empirical data collected around day 700
- Less seasonal fluctuation than previously seen (note the scale on figures)

Summary:

What got better and what got worse?

- Better:
 - Amount of seasonal fluctuation
 - Growth-consumption rate relationships
- Worse:
 - Need to push some parameters to extreme for calibration
 - Dichotomy between inverts & other species